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water. (4) Artificially prepared humus neither affected the N-fixation favorably, nor could the bacteria use it as a source of food. (5) The N-fixing power of supplies of *Azotobacter* derived from pure cultures and grown in identical conditions was extraordinarily different at optimal temperatures as well as at low and higher points. Some light may be cast on this by the following.

In an elaborate examination of the behavior of *Azotobacter*<sup>11</sup> THIELE believes that he has established incontestably that this organism is capable of accumulating N in the laboratory; but he is quite uncertain whether this power belongs specifically to it, as for example alcohol production does to yeast. It is not impossible that N-starvation in the artificial culture or the stimulation by abundance of organic matter awakens an inherent capacity of *Azotobacter* to fix N, which ordinarily slumbers. The growth of *Azotobacter* in artificial cultures is neither decisive nor typical. Its mode of action in the soil is still entirely unknown and is likely to remain so, in spite of theories, until there have been devised more exact methods of investigating the extremely minute variations of the N in soils. In view of all this uncertainty, THIELE deprecates giving agriculturists any advice which would lead them to attempt to replace Chili saltpeter by a bacterial "fertilizer."—C. R. B.

**Burbank's work.**—An interesting and illuminating account of the breeding experiments of LUTHER BURBANK is contributed by DEVRIES to the *Biologisches Centralblatt*.<sup>12</sup> It is the first statement we have seen addressed to scientific men by a man competent to appreciate both the practical and scientific aspects of BURBANK's work.—C. R. B.

**Anti-enzyme.**—With the aid of BERTEL, CZAPEK<sup>13</sup> has now elaborated the results of ten years of research devoted to developing a chemical test for tropistic sensation. Until 1897, when the author published his initial paper of this investigation, we had no way of knowing that an organ had perceived a stimulus unless it manifested response in the form of a motor reaction. In fact it was assumed that perception had not occurred unless such a motor reaction followed. FITTING, in his work on tendrils, was able by indirect methods to show that an organ may perceive a stimulus and still be incapable of executing a motor reaction. In animal irritability it has long been believed that sensations involve alterations in the metabolism of the organ. To CZAPEK belongs the honor of a fruitful pioneer research. Root tips contain tyrosin, an unstable derivative of proteids, continually yielding oxidation derivatives. The most prominent of the latter is homogentisinic acid. This research has shown that this acid is present in unstim-

<sup>11</sup> THIELE, R., Die Verarbeitung des atmosphärischen Stickstoffs durch Mikroorganismen. Landw. Versuchs-Stat. **63**:161-238. 1906.

<sup>12</sup> DE VRIES, HUGO, Die Neuzüchtungen Luther Burbank's. Biol. Centralb. **26**:609-621. 1906.

<sup>13</sup> CZAPEK, FRIEDRICH, unter Mitwirkung von RUDOLPH BERTEL, Oxydative Stoffwechselvorgänge bei pflanzlichen Reizreaktionen. (Zwei Abhandlungen.) Jahrb. Wiss. Bot. **43**:361-467. 1906.

ulated tips in about the quantity of 16 per cent., while in stimulated tips it is present to the extent of about 20 per cent. Such figures can be obtained with considerable accuracy by an improved application of the silver reduction test. The increased reduction of an ammoniacal solution of silver nitrate following stimulation (geotropic or phototropic) can be positively shown to be due to the increased quantity of homogentisinic acid. The oxidation of this acid is accomplished in ordinary metabolism by an enzyme, which because of its activity with phenol is called phenolase. The normal activity of this enzyme prevents accumulation of homogentisinic acid above *c.* 16 per cent. In consequence of stimulation, however, there arises a substance (*de novo* so far as our knowledge now goes) which inhibits the activity of the enzyme, and thus the accumulation of homogentisinic acid up to 20 per cent. is indirectly permitted. This new substance is called anti-enzyme. For different organs of the same individual and for different individuals of close systematic relationship this anti-enzyme is identical. With decreasing relationship, however, the actual substance of the anti-enzyme seems to differ, though the function remains constant. Chloroform narcosis, suffocation, antipyrin, acids, alkalies, various traumatic influences, mechanical interference with growth, and universal illumination all gave negative results for an anti-enzyme. Thus the author believes that this increased reduction of silver following stimulation is a safe and reliable test for tropistic sensation.—RAYMOND H. POND.

**Behavior of liverworts in darkness.**—NĚMEC has been experimenting with certain bryophytes which will grow in darkness and are not geotropic, to see what light they can throw on the mode of perception of geotropic stimulus, the biological significance of etiolation, and spontaneous nutations.<sup>14</sup> He finds different species behave very differently in darkness; some do not grow, others make a little growth but show no etiolation, while yet others grow long and vigorously and become markedly etiolated. Of the last, most are geotropic and grow erect or obliquely upward. But *Lejeunea bidentata* and *L. serpyllifolia* are ageotropic, having no starch or other statoliths. In darkness their shoots are completely unoriented, being at first hyponastic and then nutating irregularly. The same disorientation is observable in the sporogone of *Aneura pinguis*, but the vegetative shoots are geotropic and contain abundant statolith starch. The sporogone of *Pellia calycina* behaves similarly, but is slightly geotropic at first, losing this during elongation of the seta, which contains still some starch diffused between cell wall and vacuole and of slight mobility. The sporogone of *Pellia epiphylla*, on the contrary, is strongly geotropic and has abundant mobile starch. The sporogones of the three last named are strongly positively phototropic, and the reaction is in no way connected with the capsule. Also the upper part of the seta may be cut off, neither wound shock (which is transient) nor removal interfering with the reaction. The vegetative shoots of *Pellia calycina* grow well (plagi-

<sup>14</sup> NĚMEC, B., Die Wachstumsrichtungen einiger Lebermoose. Flora 96:409-450. figs. 9. 1906.